Multi-model assessment of the factors driving the ozone evolution over the 21st century

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The evolution of ozone from 1960 to 2100 is examined in simulations from fourteen chemistry-climate models. There is general agreement among the models at the broadest levels, with all showing column ozone decreasing at all latitudes from 1960 to around 2000, then increasing at all latitudes over the first half of the 21st century (21C), and latitudinal variations in the rate of increase and date of return to historical values. In the second half of the century, ozone is projected to carry on increasing, level off or even decrease depending on the latitude, resulting in variable dates of return to historical values at latitudes where column ozone has declined below those levels. Separation into partial column above and below 20 hPa reveals that these latitudinal differences are almost completely due to differences in the lower stratosphere. At all latitudes, upper stratospheric ozone increases throughout the 21C and returns to 1960 levels before the end of the century, although there is a spread among the models in dates that ozone returns to historical values. Using multiple linear regression the upper stratospheric ozone increase comes from almost equal contributions due to decrease in halogens and cooling from increased greenhouse gas concentrations. The evolution of lower stratospheric ozone differs with latitude. In the tropical lower stratosphere an increase in tropical upwelling causes a steady decrease in ozone through the 21C, and total column ozone does not return to 1960 levels in all models. In contrast, lower stratospheric and total column ozone in middle and high latitudes increases during the 21C and returns to 1960 levels. For all models there is an earlier return for ozone to historical levels in the northern hemisphere. This is thought to be due to interhemispheric differences in transport.